

I CLAIM:

1 1. A photodetector, comprising:

2 a monocrystalline Si well of a first conductivity type, wherein said well has a  
3 surface plane, and wherein said well contains at least one trench downwardly extending  
4 from said surface plane;

5 an undoped epitaxial layer lining said at least one trench, wherein said undoped  
6 epitaxial layer comprises a  $\text{Si}_{1-x}\text{Ge}_x$  layer with  $0 < x \leq 1$ , wherein said  $\text{Si}_{1-x}\text{Ge}_x$  layer has a  
7 thickness which is below a critical thickness, wherein a cross sectional surface of said  
8 undoped epitaxial layer forms a band which is substantially aligned with said surface  
9 plane; and

10 a second material of a second conductivity type disposed over said undoped  
11 epitaxial layer but not in contact with said band.

1 2. The photodetector of claim 1, wherein said at least one trench has a depth which is  
2 larger than said critical thickness.

1 3. The photodetector of claim 1, wherein said at least one trench has a sidewall which is  
2 substantially perpendicular to said surface plane.

1 4. The photodetector of claim 1, wherein said second material substantially fills up said at  
2 least one trench.

1 5. The photodetector of claim 1, wherein said second material is selected from the group  
2 consisting of monocrystalline Si in epitaxial relation with said undoped epitaxial layer,  
3 polycrystalline Si, amorphous Si, polycrystalline SiGe, amorphous SiGe, polycrystalline  
4 Ge, amorphous Ge, and their combinations thereof.

1 6. The photodetector of claim 1, wherein said  $\text{Si}_{1-x}\text{Ge}_x$  layer is essentially pure Ge.

1 7. The photodetector of claim 1, wherein said undoped epitaxial layer consists essentially  
2 of  $\text{Si}_{1-x}\text{Ge}_x$ .

1 8. The photodetector of claim 1, wherein said first conductivity is p-type and said second  
2 conductivity is n-type.

1 9. The photodetector of claim 1, wherein said first conductivity is n-type and said second  
2 conductivity is p-type.

1 10. The photodetector of claim 1, further comprising a first electrical contact to said Si  
2 well and a second electrical contact to said second material.

1 11. The photodetector of claim 1, wherein said Si well has a first doping level, and  
2 wherein said Si well is in contact with a monocrystalline Si body of said first conductivity  
3 type, wherein said Si body has a second doping level, and wherein said first doping level  
4 is higher than said second doping level.

1 12. The photodetector of claim 1, wherein said Si well has a first doping level, and  
2 wherein said Si well is a monocrystalline Si body.

1 13. The photodetector of claim 1, wherein said Si well is in contact with a  
2 monocrystalline Si body of said second conductivity type.

1 14. A method for fabricating a photodetector, comprising the steps of:  
2 growing by lateral epitaxy an undoped layer lining a trench, wherein said trench is  
3 in a monocrystalline Si well of a first conductivity type, wherein said undoped epitaxial  
4 layer comprises a  $\text{Si}_{1-x}\text{Ge}_x$  layer with  $0 < x \leq 1$ , and wherein said  $\text{Si}_{1-x}\text{Ge}_x$  layer is selected to  
5 have a thickness below a critical thickness; and  
6 covering said undoped epitaxial layer with a second material, wherein said second  
7 material is of a second conductivity type

1 15. The method of claim 14, further comprising the step of filling said trench with said  
2 second material.

1 16. The method of claim 14, further comprising the steps of:

2 producing said trench, wherein said trench has a sidewall and a bottom; and

3 doping said sidewall and said bottom with dopants of said first conductivity type.

1 17. The method of claim 14, further comprising the step of forming a smooth top surface  
2 for said photodetector, wherein said smooth top surface comprises:

3 a surface plane of said Si well;

4 a cross sectional surface band of said undoped epitaxial layer; and

5 a surface area of said second material.

1 18. The method of claim 14, further comprising the step of selecting said  $\text{Si}_{1-x}\text{Ge}_x$  layer to  
2 be essentially pure Ge.

1 19. The method of claim 14, further comprising the step of reverse biasing said Si well  
2 with respect to said second material.

1 20. The method of claim 14, further comprising the step of selecting said first  
2 conductivity as p-type and said second conductivity as n-type.

1 21. The method of claim 14, further comprising the step of selecting said first  
2 conductivity as n-type and said second conductivity as p-type.

1 22. The method of claim 14, further comprising the step of selecting said second material  
2 from the group consisting of monocrystalline Si in epitaxial relation with said undoped  
3 epitaxial layer, polycrystalline Si, amorphous Si, polycrystalline SiGe, amorphous SiGe,  
4 polycrystalline Ge, amorphous Ge, and their combinations thereof.

1 23. The method of claim 14, further comprising the step of reverse biasing said Si well  
2 with respect to a monocrystalline Si body which contacts said Si well, wherein said Si  
3 body is selected to have said second conductivity type.